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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
BLUM, DAVID S	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 03/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/604,905	BURNHAM ET AL.	
	Examiner	Art Unit	
	David S. Blum	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 December 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4 and 6-38* is/are pending in the application.

4a) Of the above claim(s) *16-30* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,6-15 and 31-38* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1,4 and 6-38* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *26 August 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

This action is in response to amendment filed 12/05/05.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 7-15, and 31-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi (EP 0 886 308 A2) in view of Senzaki (US 20060051506A1).

Kobayashi teaches all of the positive steps of claims 1, 7-15, and 31-33 except for the limitations regarding the equipment used.

Regarding claim 1, Kobayashi teaches forming a silicon dioxide layer on a top surface of a substrate (column 2 line 55) performing a plasma nitridation in a reducing atmosphere to convert the silicon dioxide into a silicon oxynitride layer (column 3 lines 13-28, reaction gases listed include reducing atmosphere gasses). Kobayashi teaches nitridizing with a plasma, but does not teach where the plasma is made or how it is introduced (Although its introduction into the chamber suggests a second chamber for making the plasma). Senzaki teaches forming a silicon oxide (high-k silicon oxide) on a

substrate and introducing a nitrogen plasma into the chamber (thus two chambers) (abstract). The nitrogen plasma (thus at least one nitridation species) is made in a separate chamber (paragraph 0022) and introduced via a gas delivery system (one inlet connecting the two chambers) the chamber containing the substrate also has a system for purging, thus a second inlet (paragraph 0016). Senzaki does not teach that the two chambers are adjacent, but as they are connected by an intake (gas delivery injector) it is obvious they are near each other, thus adjacent.

Regarding claim 7, the substrate is silicon (or others column 3 lines 5-13), and the silicon dioxide layer is formed by thermal oxidation (and other methods, column 3 lines 1-5).

Regarding claim 8, the silicon oxide layer is about 8-23 angstroms (column 2 lines 55-56, 1-20nm=10-100 angstrom).

Regarding claim 9, Kobayashi does not teach a resultant silicon oxynitride layer of about 8-24 angstroms, but does teach the goal of the invention to have a resultant gate insulating film of 3nm (30 angstroms) or less (column 1 lines 29-30), which is about 8-24 angstroms.

Regarding claim 10, the nitrogen content in the silicon oxynitride is between about 2-20 percent (11 %, column 9 line 34).

Regarding claim 11, the nitrogen content in the silicon oxynitride is between about 1E21 and 1E22 atm/cm3 (11 %, column 9 line 34). This is the same concentration as listed in claim 10, only another way of describing the concentration.

Regarding claim 12, Kobayashi teaches nitridizing a silicon dioxide as in claim 1, which results in the same nitrogen concentration (as in claim 10 above), therefore, it is obvious to one skilled in the requisite art that the same dosage would be imparted.

Regarding claim 13, Kobayashi is silent as to the growth of the silicon oxynitride as to the silicon oxide layer, but teaches the resultant oxynitride layer cannot be made greater than a certain level (column 1 lines 56-57). Further, Kobayashi teaches the nitrogen to be incorporated into the silicon oxide film, but does not teach or suggest any thickness growth, only control of the resulting thickness. Thus without evidence to the contrary, Kobayashi suggests a growth of 0-35%.

Regarding claim 14, Kobayashi is silent as to the thickness of the resulting layer's mean thickness varying by no more than 0.5 angstrom sigma from a center to an edge of the substrate. However, Kobayashi teaches the method (which is identical to that of the instant claims) for improved control of the resultant film. Thus without evidence to the

contrary, the method of Kobayashi will result in the mean thickness varying by no more than 0.5 angstrom sigma from a center to an edge of the substrate.

Regarding claim 15, Kobayashi is silent as to the nitrogen concentration not varying by more than 25% from a center to an edge of the substrate. However, Kobayashi teaches the method (which is identical to that of the instant claims) for improved control of the resultant film. Also, Kobayashi teaches a concentration gradient only with the depth of the thickness, suggesting a uniform concentration along the surface. Thus without evidence to the contrary, the method of Kobayashi will result in the mean thickness varying by no more than 0.5 angstrom sigma from a center to an edge of the substrate.

Regarding claim 31, the nitrogen plasma (Senzaki) of the second chamber is sent to the first chamber, thus the second chamber is exhausted through the first chamber.

Regarding claim 32, Senzaki generates a nitrogen, inert gas and reducing gas in the second chamber and transfers it to the first chamber through a first inlet port (see figures 1 and 4).

Regarding claim 33, Kobayashi teaches an inert gas such as argon, neon, or like gas (column 11 line 56), and ammonia (NH3 as the hydrogen source). Senzaki teaches the inert gas is argon or helium, giving the two an art recognized equivalence, the reducing gas is ammonia (paragraph 0041).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Kobayashi by using the remote nitridizing system as described by Senzaki as it was commercially available at the time of the instant invention rather than spend research time and money developing new equipment.

3. Claim 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi (EP 0 886 308 A2) in view of Senzaki (US 20060051506A1) and in further view of Park (US006962873B1).
Kobayashi teaches all of the positive steps of claim 34 as recited above in regard to claim 32, except for using hydrogen as the reducing gas.

Regarding claim 34, Kobayashi teaches an inert gas such as argon, neon, or like gas (column 11 line 56), and ammonia (NH3 as the hydrogen source). Senzaki teaches the inert gas is argon or helium, giving the two an art recognized equivalence, the reducing gas is ammonia (paragraph 0041). Park nitrides a cobalt layer. Although a different material, the teachings of Park are relevant here. Park teaches using ammonia as the nitrogen species, or a mixture of nitrogen and hydrogen (column 7 lines 15-30). Thus substituting nitrogen and hydrogen for ammonia is an art recognized equivalent. Further, in a plasma, ammonia breaks down into nitrogen and hydrogen. Also, Park teaches additional hydrogen may be used with ammonia (column 7 lines 27-29).

It is also noted that the instant specification teaches using ammonia or nitrogen and hydrogen without any teaching of criticality.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or of any unexpected results arising there from. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in the claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1515, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Kobayashi and Senzaki by substituting nitrogen and hydrogen for ammonia as taught by Park to be an art recognized equivalent.

4. Claims 35-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi (EP 0 886 308 A2) in view of Senzaki (US 20060051506A1) and in further view of McFadden (US 6610615 B1).

Kobayashi teaches all of the positive steps of claims 35-38 as recited above in regard to claim 1, except for specific gasses and how the gasses are placed into the chamber.

Regarding claim 35, Senzaki generates a nitrogen, inert gas and reducing gas in the second chamber and transfers it to the first chamber through a first inlet port (see

figures 1 and 4).Kobayashi teaches an apparatus where the gasses are flowed into a single gas inlet in the chamber (figure 10). However, Kobayashi teaches that the gasses may react singly or in combination (column 10 lines 36-39) suggesting that there is no resultant product change dependent upon whether the gasses are placed into the chamber through a single inlet or multiple inlets. Without evidence to the contrary, this limitation is an apparatus limitation rather than one on the actual process of making a film.

Regarding claim 36, the inert gas is helium, the reducing gas is ammonia (paragraph 0041).

Regarding claim 37, the inert gas is helium, the reducing gas is ammonia (paragraph 0041).

Regarding claim 38, Kobayashi and Senzaki are silent as to how the plasma is formed. McFadden (column 3 lines 30-33) teaches a plasma made with radio frequency.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Kobayashi by using helium as the inert gas as taught by McFadden because helium has a lower ionization energy (abstract).

Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi (EP 0 886 308 A2) in view of McFadden (US 6610615 B1).

Kobayashi teaches all of the positive steps of claim 6, except for the inert gas being hydrogen.

Kobayashi teaches forming a silicon dioxide layer on top of a silicon substrate (column 2 line 55), performing a plasma nitridation in a reducing atmosphere to convert the silicon dioxide into a silicon oxynitride (column 3 lines 13-28), reaction gasses listed include reducing atmosphere gasses). McFadden teaches using helium because helium has a lower ionization energy (abstract).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Kobayashi by using helium as the inert gas as taught by McFadden because helium has a lower ionization energy (abstract).

Response to Arguments

5. Applicant's arguments with respect to claims 1, 4, and 6-15 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (571)-272-1687) and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached at (571)-272-1702. Our facsimile number all patent correspondence to be entered into an application is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David S. Blum
March 27, 2006